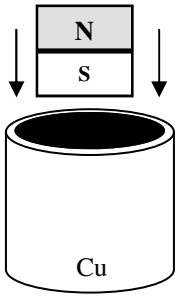
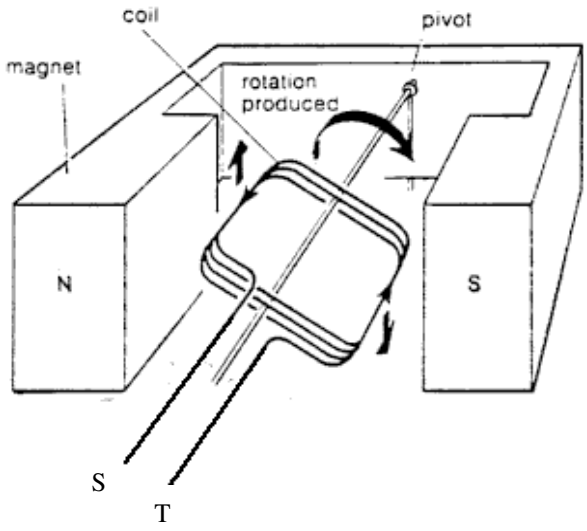
PreAP Magnetism 9



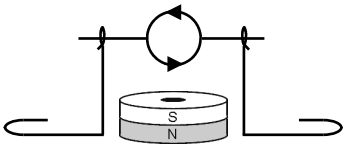
1. A magnet is dropped into a copper tube.
   A. Is the magnet attracted to the copper tube?
   B. Is the copper a hard or soft magnetic material?
   The magnet drops slowly thru the tube at constant speed, so there must be a magnetic force opposing gravity.
   C. To keep the magnet from falling, which way must the induced magnet face?
   You should have chosen N facing down, so your thumb faces down with your fingers curled.
   D. To create this magnet which way is the induced current flowing in the tube (*as seen from above*)?



2. The diagram at the left shows a loop of wire moving inside a horseshoe magnet. The loop rotates clockwise around the pivot.
   A. Which direction does the magnetic field point?
   B. When does the rotating loop cut more magnetic field lines, when it is horizontal or vertical?
   C. When does the loop create a stronger emf (voltage), when horizontal or vertical?
   D. Remembering that the wire is your thumb, which side will the induced current flow: out point T or point S? (*You can either use the right hand rule on either side of the loop OR Lenz's Law.*)
   E. During an entire rotation (360º) will the moving loop produce AC or DC voltage (emf)?

      So, the emf be negative during one half of the rotation and positive during the other half.
   F. How do the peak magnitudes of the negative and positive emfs compare?

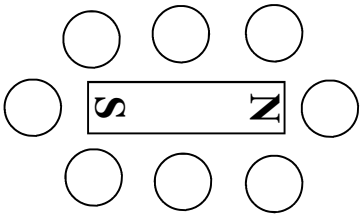
3. Below is an example of a rudimentary motor. The current in the loop of the motor is turning CCW.

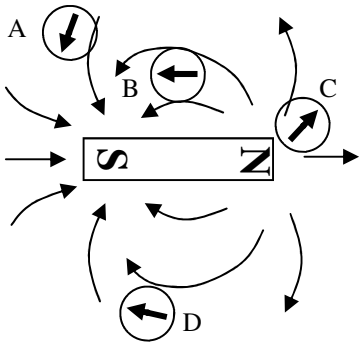


   A. Is the north pole of the loop facing out of or into the page?
   B. Label front face of the loop as a N or S.
   C. The electromagnetic of the loop will interact with the permanent magnet below it. Will the front of the loop rotate up or down?

      This is how motors work: electromagnets interact with permanent magnets, causing magnetic forces and motion.

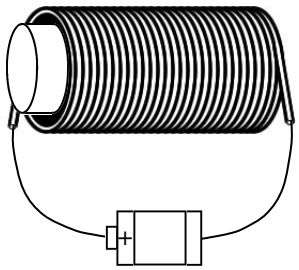
4. A. Magnetic field lines point from ____ to ____.
   B. Draw the magnetic field lines around the top and bottom of the bar magnet.
   C. Realizing that compasses will point tangent to the magnetic field lines, draw the compasses around the bar magnet.





5. Four compasses are placed around a bar magnet.
   A. Which compass is at a position where the magnetic field is strongest?
   B. Which compass feels the weakest magnetic field?
   C. Which compass feels equal pull from the north and south side of the bar magnet?
   D. If the bar magnet represents the earth's magnetic field, label the north pole of the earth at the appropriate side of the bar magnet.

6. A piece of iron (iron core) is placed inside a solenoid, which is connected to a battery, as shown.



A. Since conventional current flows from positive to negative, draw an arrow to show the direction of the current out of the battery.

B. Determine which side of the solenoid is its north pole.

C. Draw the magnetic field lines around the solenoid.

D. What reason would there be for an iron core to be in the solenoid?

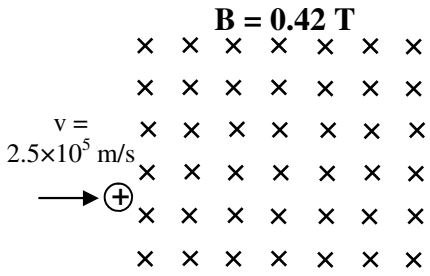
E. Is the iron a soft or hard magnetic material?

F. Before the battery is connected, are the magnetic domains in the iron aligned or random?

G. When the battery is connected, are the magnetic domains in the iron aligned or random?

Let me walk you thru the next question.

7. A doubly ionized carbon atom moving 2.5×10^5 m/s enters perpendicular to a 0.42 T magnetic field.



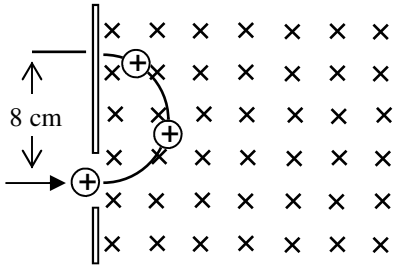
A. What will be the path of the positive charge (be specific)?

B. * "Doubly ionized" means two electrons have been ripped off the atom, giving it a double + charge. What is the charge of the ion?

C. * Calculate the magnetic force on the atom.

D. *Since the charged atom moves in a circle, what equation do we put into F = ma for the acceleration?

The carbon atoms then hit a phosphorus surface and give off light. A few of the ions though go farther than majority. The distance from where these ions enter the magnetic field to where they hit the phosphorus is measured to be 8 cm.



E. * What is the radius of the path?

F. Put all the above together and calculate the mass of the ion.

G. Most Carbon is Carbon 12. If 1 proton ≈ 1 neutron = 1.67×10^{-27} kg, what is the atomic mass of the stray ions?

The above question describes part of a "mass spectrometer". This is how scientist discovered isotopes. They isolated ions with the same chemical properties (same element), same velocity and same charge. They discovered that some of the ions had larger or smaller radii, meaning they had more mass, but no more charge. Therefore there must be a particle in the atom with mass, but not charge: the neutron.

7B) 2(1.6E−19C) 7C) F = qvB 7D) $a = v^2/r$
7E) 8 cm is the diameter. Work in meters.